

# DOE/DER Peer Review

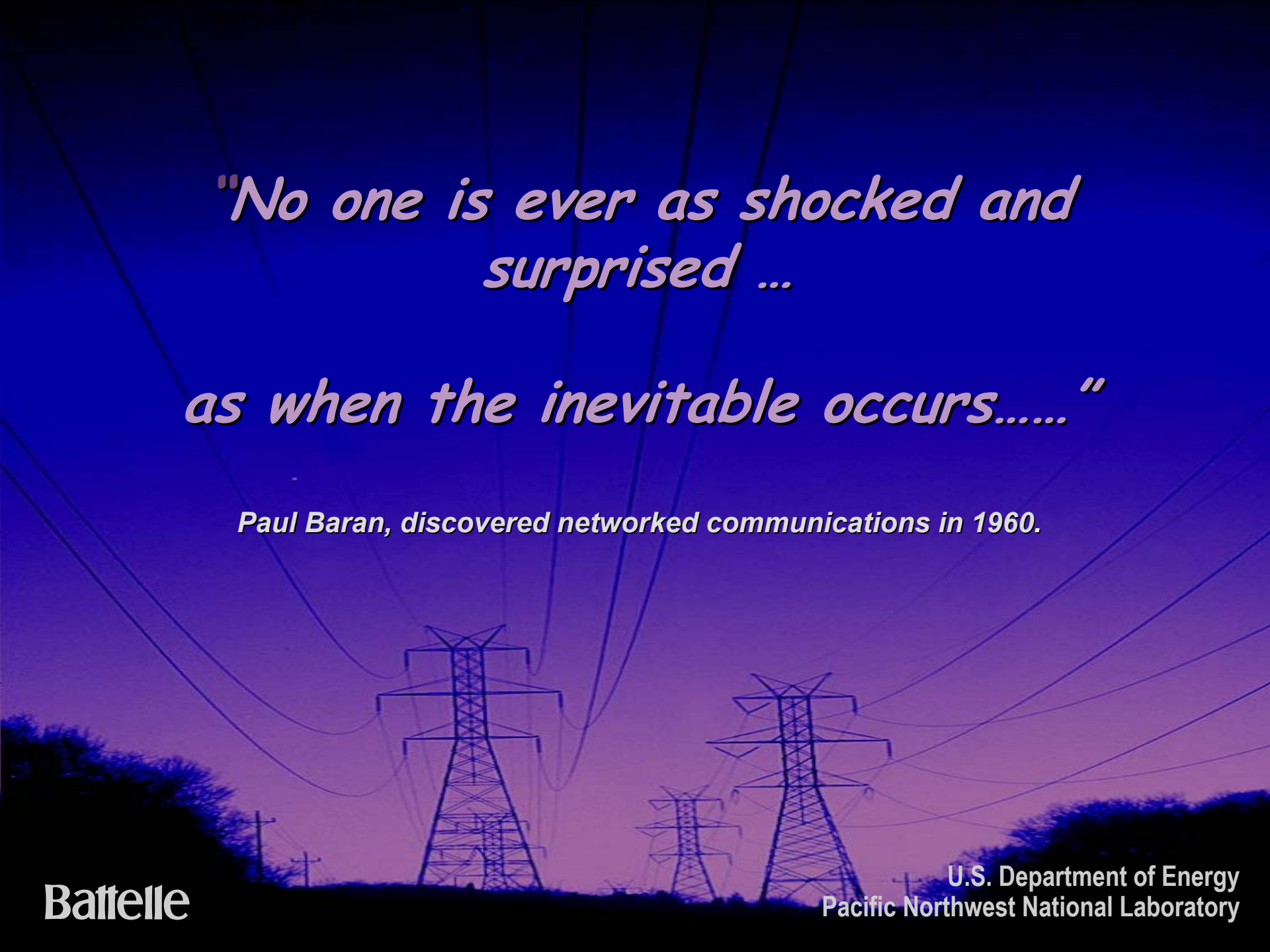
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## *Transforming the Energy System*

### *"The Power of Networks"*

*Nov. 30, 2001*

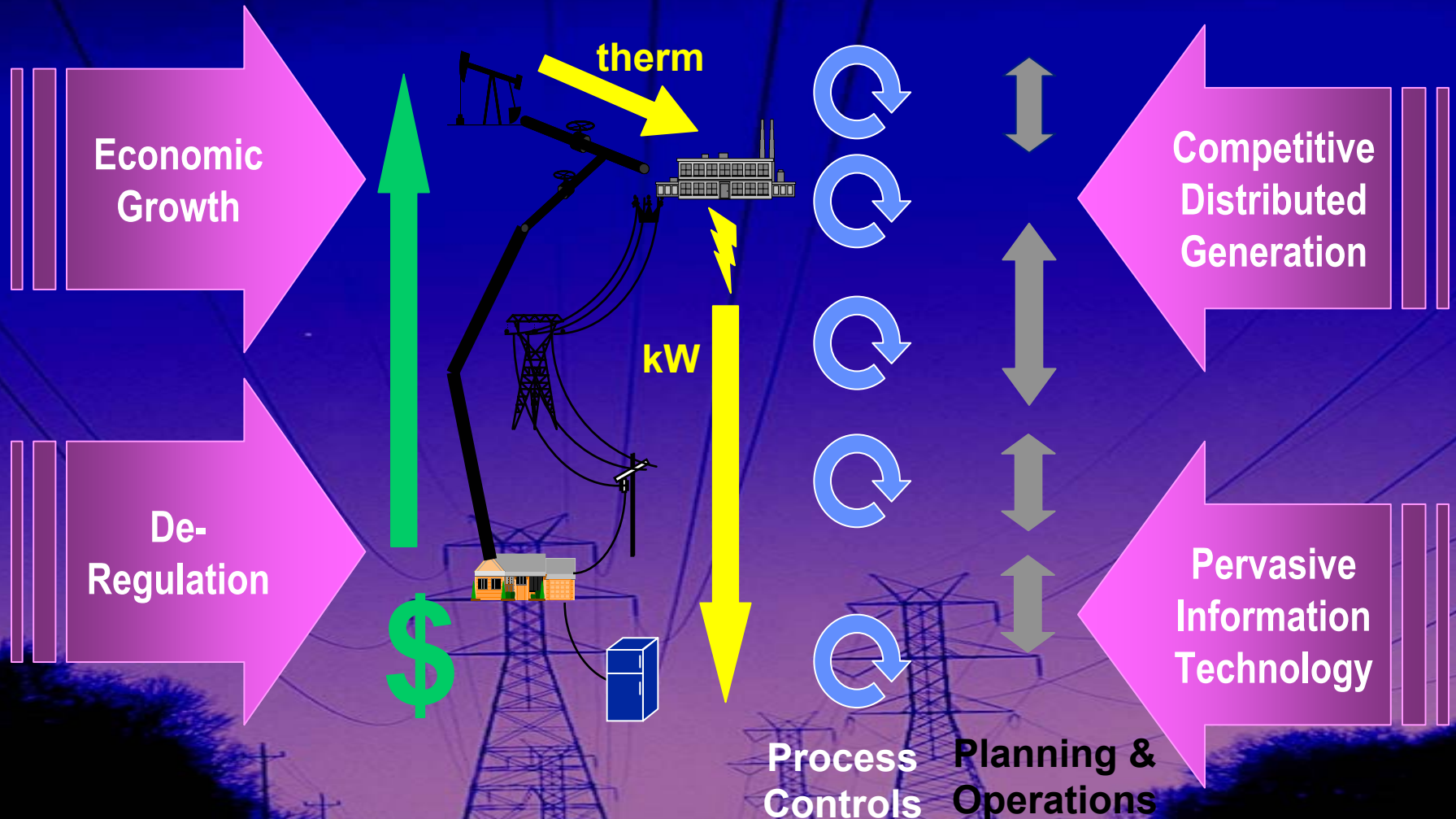
*Steve Hauser*



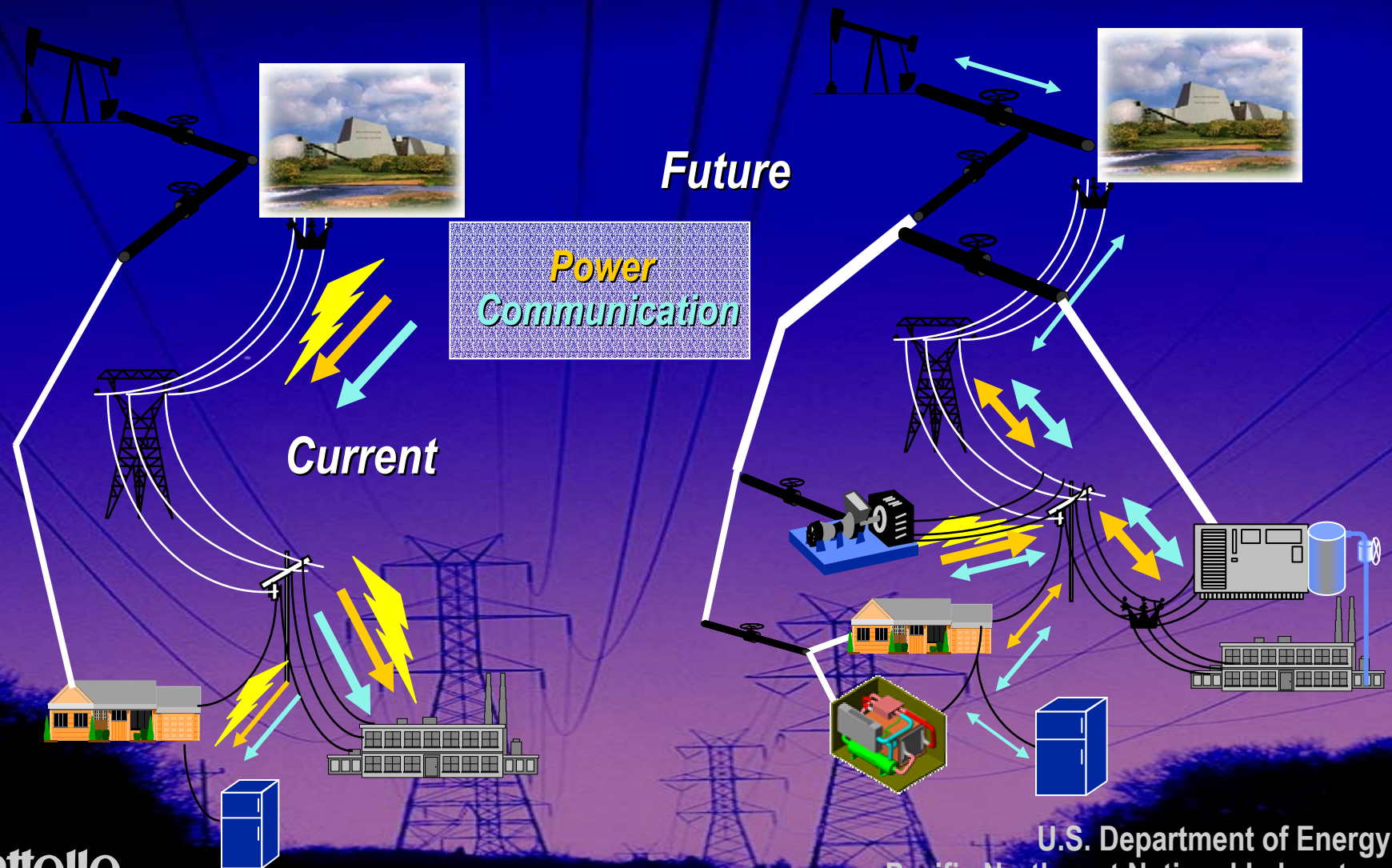
*"No one is ever as shocked and surprised ...  
as when the inevitable occurs....."*

*Paul Baran, discovered networked communications in 1960.*

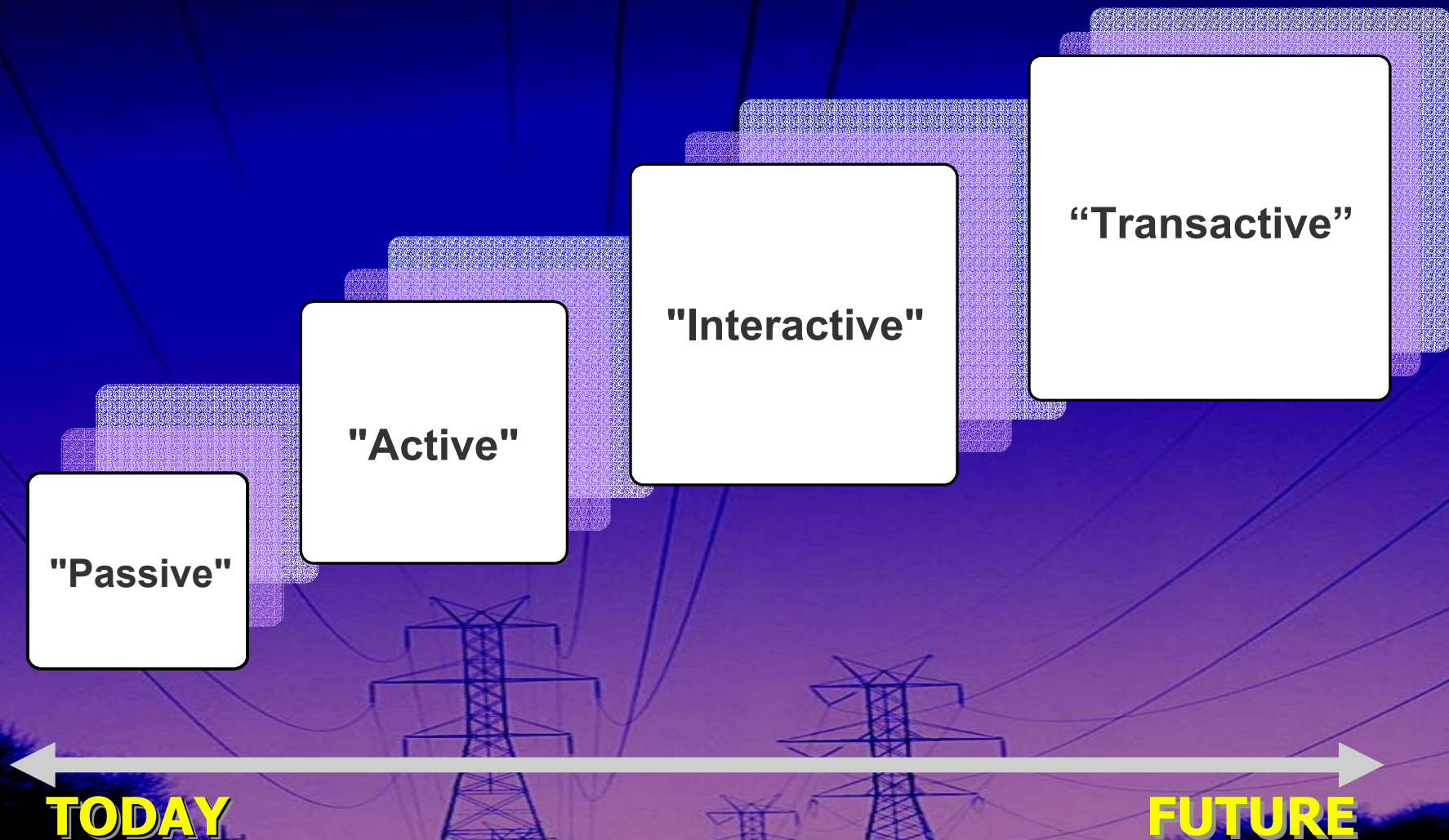
# Forces Changing Today's Linear Energy Networks



# The Future Energy System Will Evolve to Facilitate Open Markets ...



# Energy System Evolutionary Phases



# A Key Challenge – Topological Resolution

## Element

## Ratio

## Nodes\*

Generation

10:1

$\sim 10^2$

Transmission

10:1

$\sim 10^3$

Substations

5:1

$\sim 10^4$

Distribution Feeders

*res =  $10^3$ :1, com =  $10^2$ :1, ind =  $10$ :1*

$\sim 5 \times 10^4$

Customer Meters

10:1

$10^2$ :1

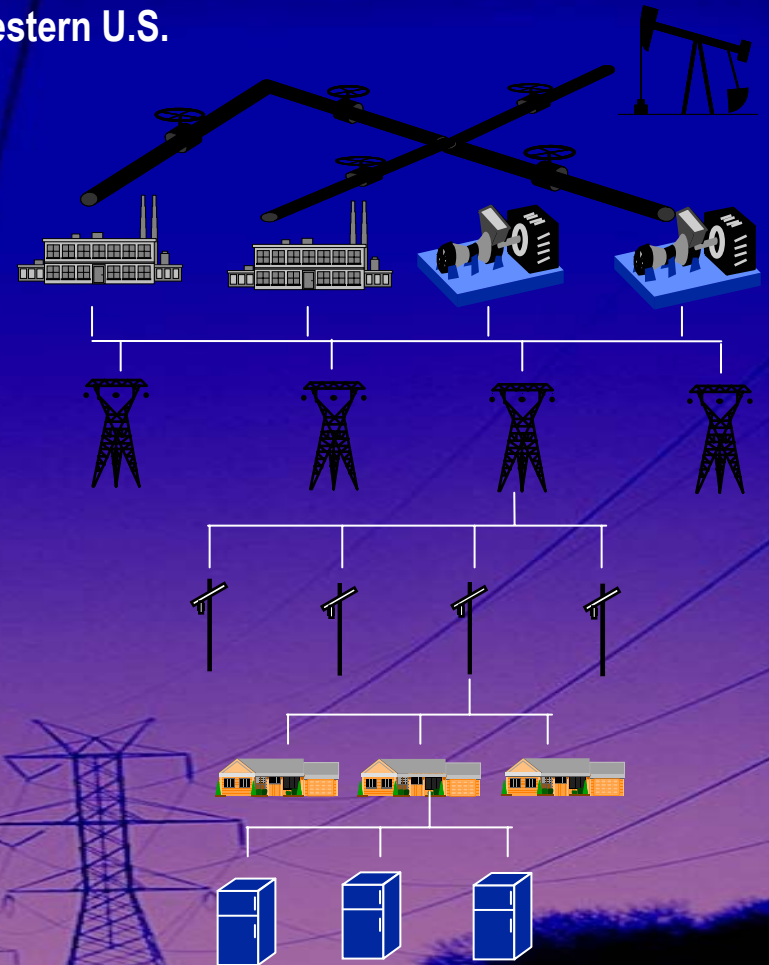
$10^3$ :1

$\sim 10^7$

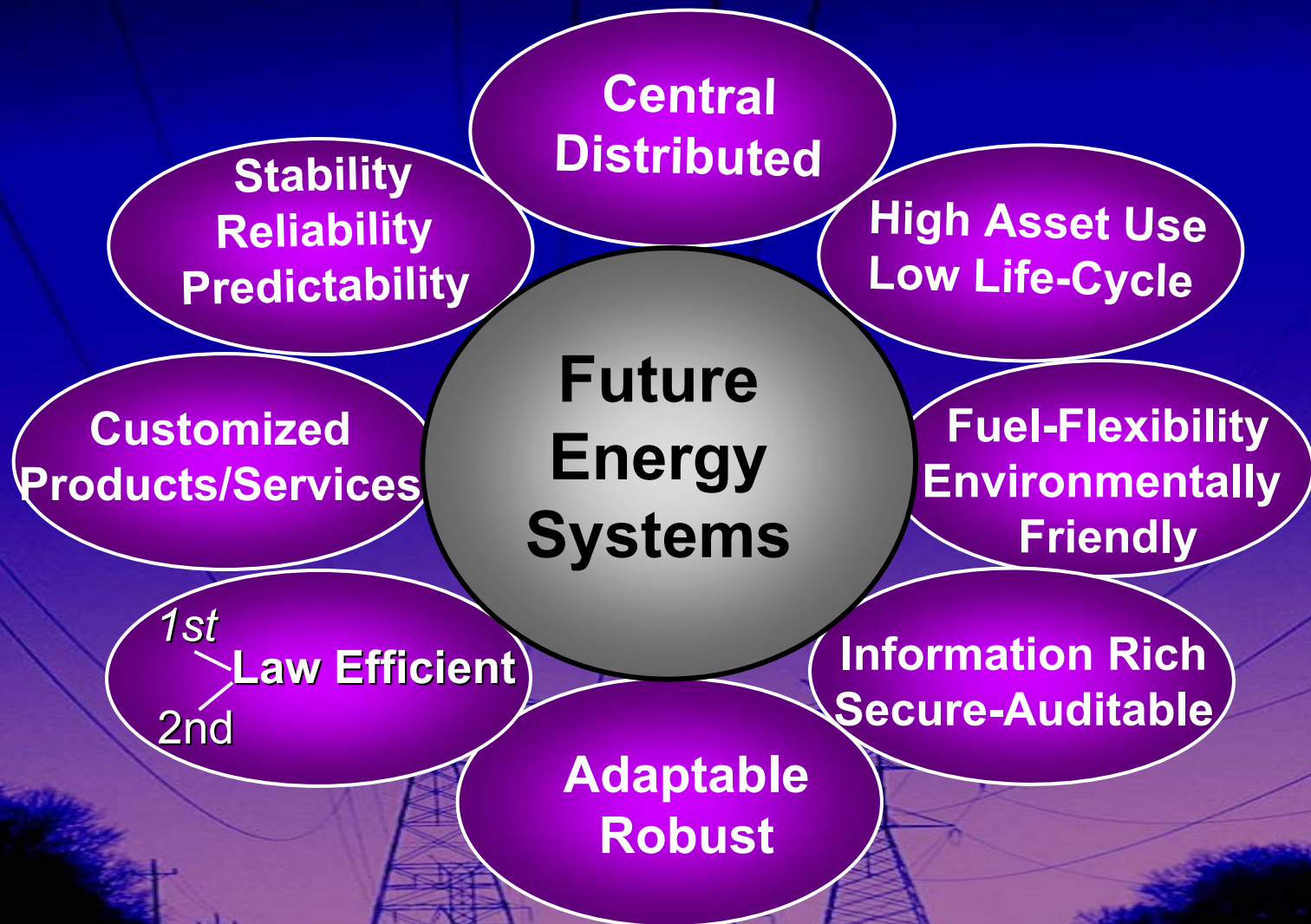
Appliances/Equipment

$\sim 5 \times 10^8$

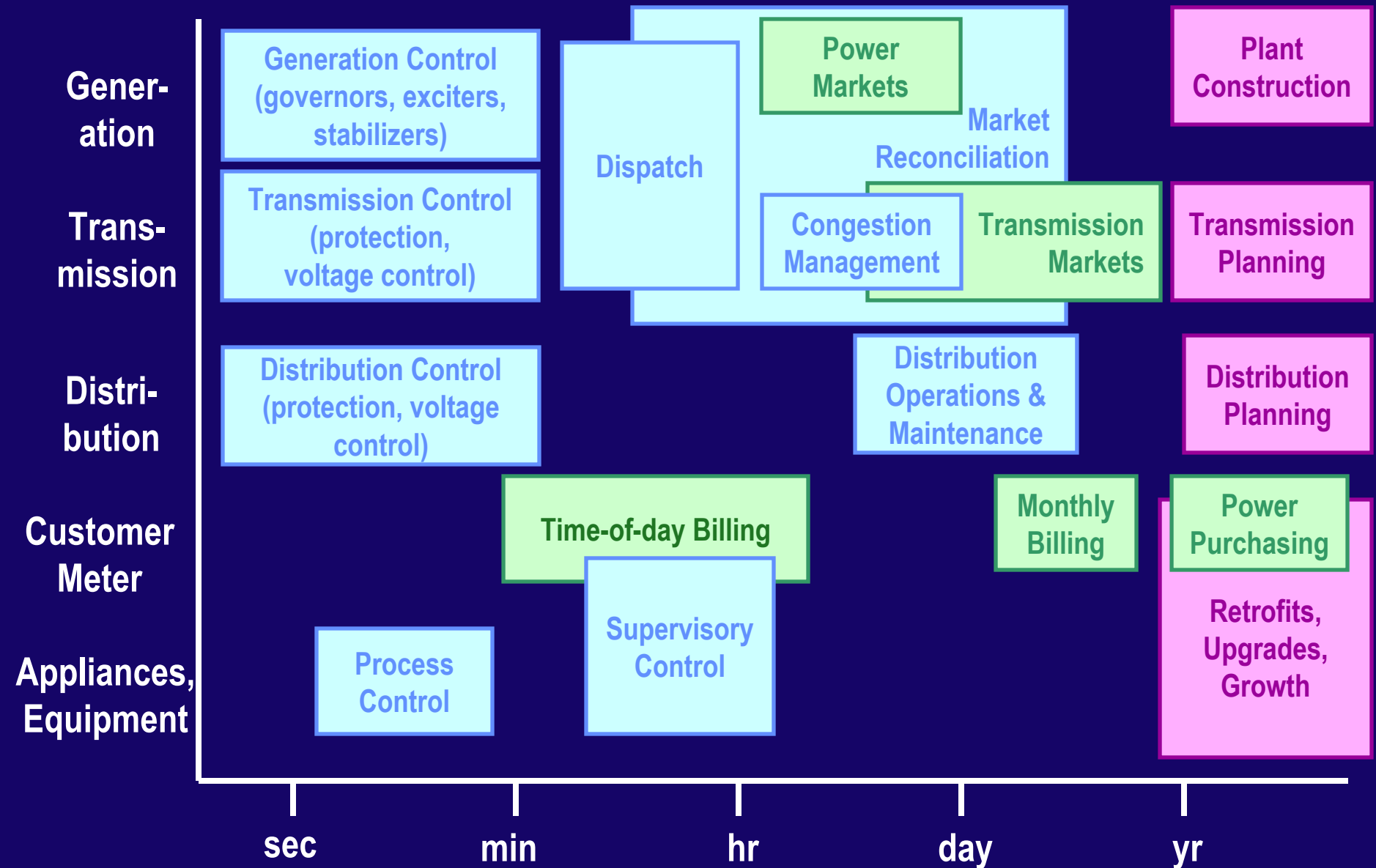
\*Western U.S.



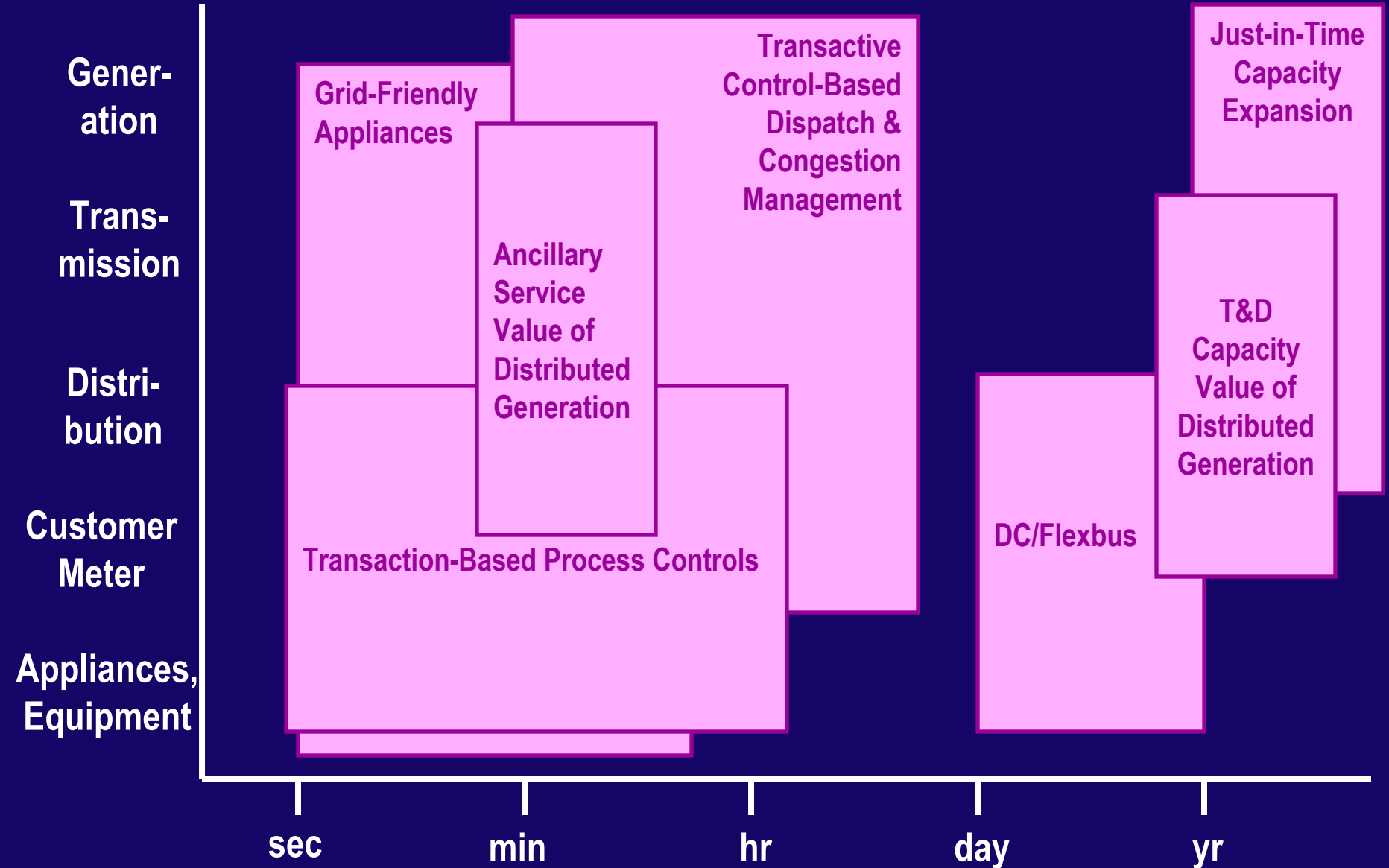
# A Vision for the Future



# Today's Energy System Operations



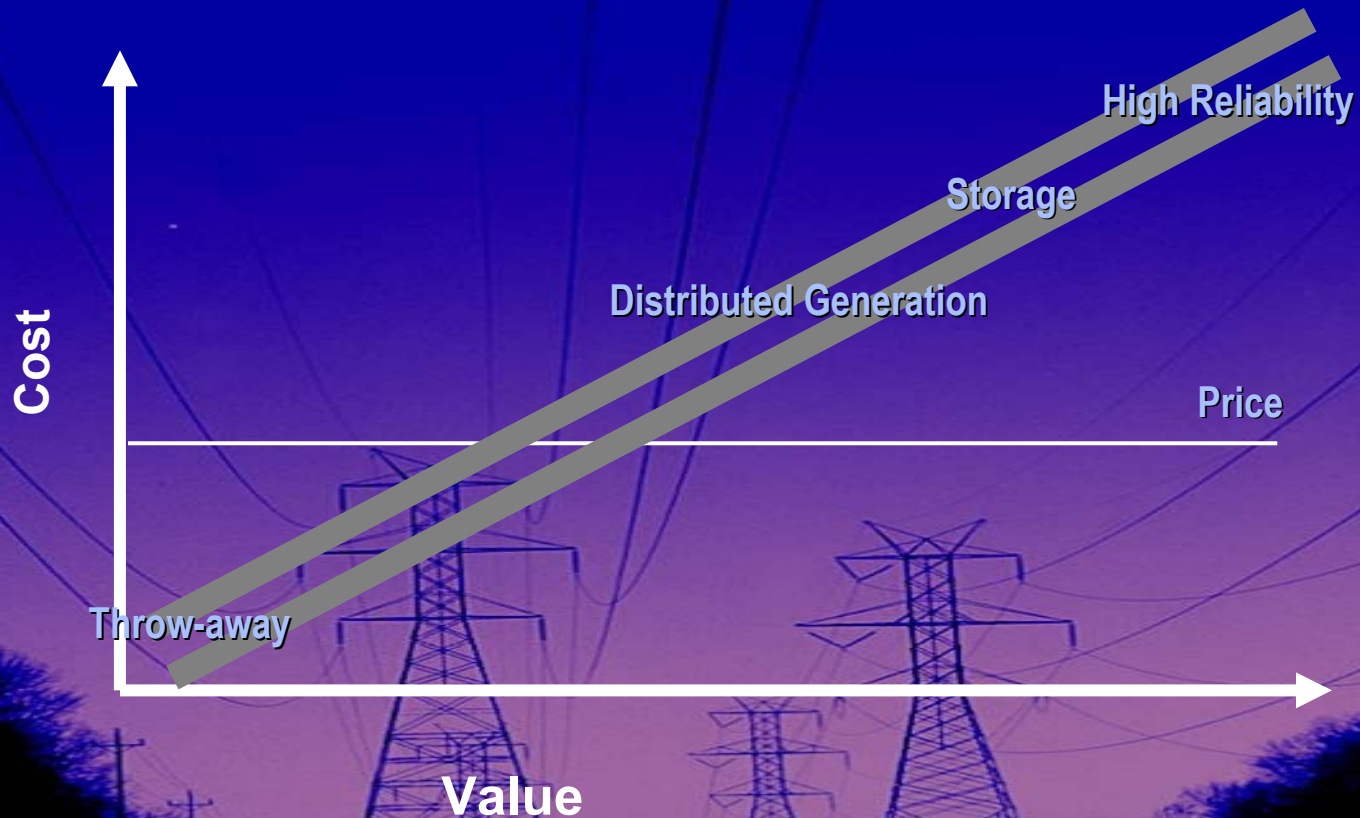
# Potential New Markets



# Better Information Uncovers Hidden Value

- Heat
- PQ (Power Quality)
- Capacitance
- Load & power factor
- Harmonics
- Ancillary Services
- Air Quality
- Avoided cost

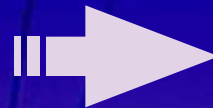
# Understanding Value Drives New Markets



# Keystone Workshop

50 participants from 30+ companies

Functional Objectives



R&D Needs

Significant Industry Consensus

Summary Report Available

## *Example Companies Involved.....*

- ◆ IBM
- ◆ Cisco Systems
- ◆ 6<sup>th</sup> Dimension
- ◆ Alstom
- ◆ ABB
- ◆ Tridium
- ◆ Enron
- ◆ Celerity
- ◆ Bonneville Power
- ◆ Seattle City Light
- ◆ Motorola
- ◆ Cinergy
- ◆ American Electric Power

# Federal R&D Opportunities

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***Communication  
Infrastructure***

***Information  
Networks***

***Economic/System  
Model***

***Market/Operation  
Simulation***

***Control  
Technologies***

***System  
Applications***

***Test/Validation  
Facilities***

***Pilot Projects***